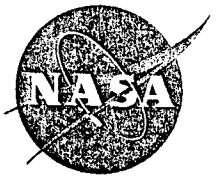
National Aeronautics and
Space Administration
Office of the Administrator
Washington, DC 20546-0001



September 30, 2002

The Honorable Ralph M. Hall
Ranking Democrat
Committee on Science
House of Representatives
Washington, DC 20515

Dear Mr. Hall:

Thank you for your letter of June 13, 2002, forwarding a number of questions related to NASA's decision to implement an orderly shut down of the X-38 project in favor of the pursuit of multipurpose vehicle concepts.

Over the past few months, NASA has conducted a number of reviews to assess the Integrated Space Transportation Plan (ISTP), which includes the Space Launch Initiative (SLI), the Space Shuttle hardware and infrastructure upgrades, and the longer-term 3rd Generation Reusable Launch Vehicle Program. The ISTP update has incorporated the ongoing reviews of the Space Shuttle Program, and has included an assessment of the timetable for a multipurpose vehicle to serve crew transfer and crew return functions. I anticipate that the ISTP review will conclude shortly. The outcome of the ISTP update will be a roadmap for future investment decisions, and it is likely to result in modifications to the current program.

Enclosed herewith are responses to your questions, which reflect a snapshot of NASA's current analysis. Our assessments will mature as the ISTP update is completed and as the FY 2004 budget formulation process continues.

I would be pleased to discuss NASA's current assessment with you personally, at your convenience, and will be pleased to keep you informed as NASA reaches conclusions on an updated ISTP plan.

Cordially,

Sean O'Keefe
Administrator

Enclosure

ENCLOSURE

Crew Transfer Vehicle (CTV) Alternative

1. **Previous testimony to Congress and briefings to this Committee have indicated that a Crew Transfer Vehicle (CTV) would not be available under the planned Space Launch Initiative (SLI) schedule until 2011. Do you still stand by that timetable?**

   The baseline Space Launch Initiative (SLI) program has had as an objective to provide a next-generation Reusable Launch Vehicle (RLV) capability, including a Crew Transfer Vehicle (CTV), in 2012.

   NASA is currently reviewing the total set of Agency space transportation requirements as part of an update of NASA's Integrated Space Transportation Plan (ISTP). The ISTP includes the SLI program (including the CTV), the Space Shuttle hardware and infrastructure upgrades, and the longer-term "3rd Generation" RLV research and technology effort. The ISTP update is addressing the timetable for a CTV. The update is also incorporating ongoing reviews of the Space Shuttle Program, which include NASA's assessment of the technical and budgetary requirements for continued safe operation of the Space Shuttle until 2020, and the continuing examination of Space Shuttle competitive sourcing options. The outcome of the ISTP update will be a roadmap for investment decisions, and it is probable that modifications will be made to the current program.

2. **If you believe that development of a CTV could be accelerated, what date for the availability of a flight-tested, operational CTV do you consider to be realistic? What is the analytical basis for the changed availability estimate, and what changes to SLI would have to be made to realize an earlier CTV availability date?**

   As indicated in NASA's June 13, 2002, letter to the Congress, NASA is examining three basic strategy options to support crew return and crew transfer functions:

   - A common vehicle;
   - A vehicle with a common outer mold line, but with different internal configurations; and,
   - Multiple vehicles.

   Some of these options could be achieved in an evolutionary manner, i.e. initial configurations of a CTV could provide crew rescue capabilities that are later expanded to include crew transfer functions.

In June, the SLI program completed an initial study of combining crew rescue requirements with crew transport requirements to determine the feasibility of developing a multi-purpose crewed system. The study considered the feasibility of accelerating CTV development. Cost and schedule were assessed at a preliminary level, and 2010 was estimated as the earliest availability date for a CTV, most likely with an initial configuration dedicated to crew rescue function. The risks associated with the accelerated schedule have not been fully defined. NASA is continuing to assess the risks and issues associated with an accelerated CTV schedule, as part of the ISTP update.

It should be noted that NASA has refined its philosophy concerning the approach to ISS crew rescue. NASA clearly sees a requirement for the capability to provide crew rescue for all crew onboard the ISS, and is seeking to pursue a multipurpose vehicle to satisfy this requirement. At the same time, NASA has concluded, based upon extensive consultations with the Astronaut Office, that capabilities onboard the ISS should be maximized to address adverse situations, recognizing that ISS crew would abandon the ISS only if/when a situation onboard the ISS became untenable. As a result, we believe that it is prudent to enhance our medical diagnostics and treatment capability, and, where practical, rely on the inherent safe haven capability to enable the crew to remain onboard, while at the same time providing crew return capability for the entire ISS crew when warranted by crew judgment.

3. **If a CTV were developed on an accelerated schedule, when would the Space Shuttle be phased out as the means of supporting the ISS? If the intention is to maintain Shuttle support of the ISS after the CTV becomes available, what additional crewed access-to-space requirements has NASA identified to justify the additional capability that would be provided by the CTV during that time period?**

These issues are being reviewed as part of the ISTP update. If a CTV were operated in tandem with Shuttle, it would provide a rescue capability for ISS, support assured access to ISS should Shuttle have difficulties or international partner contributions fail to materialize, and support transition to a Shuttle replacement when a new RLV is ready.

4. **How would the CTV be launched? When realistically would such a launch capability be available to support CTV launch operations? What would have to be done to human rate such a launch capability? What is the analytical basis for concluding that such an approach would be feasible and cost-effective?**

The baseline SLI plan assumes launch of a CTV on a new human-rated RLV.

If the Agency were to accelerate CTV development ahead of the availability of an RLV booster, an expendable launch vehicle (ELV) would be required to deliver

the CTV to the ISS. To support this potential option, NASA is identifying the reliability modifications and flight demonstrations required to human-rate an ELV system. NASA is evaluating this option, among others, to determine whether this approach meets cost and safety requirements for support of ISS. However, if the initial version of a CTV were configured to perform the crew return vehicle (CRV) function, and were launched on an ELV to the ISS without crew, human rating of the ELV would not be required. There are some estimates that this capability could be available as early as 2010. The ISTP update is establishing the analytical basis for this projected availability, supported by an independent review.

5. **What is the estimated cost to develop a CTV? What would be the per-vehicle cost? What is the basis for that cost estimate, and has it been independently validated? Does it include the cost of human-rating a launch vehicle for the CTV?**

   Firm cost estimates have not been established for development of a CTV. However, for preliminary planning purposes, initial estimates have been formulated for development of a CTV with various IOC dates and operational capabilities. These estimates are being refined as part of the ISTP update and FY 2004 budget decisions.

6. **The Department of Defense has not indicated any requirement for a crewed reusable launch vehicle (RLV) capability. What would be the relative priority of a CTV development in a joint NASA-DOD RLV program?**

   The Agency has worked diligently with the DOD in the identification of common space transportation needs. Certain CTV technologies could provide considerable potential benefit in the development of an RLV capability or a military space plane. A common booster stage that serves both NASA and the DOD is a potentially attractive option. NASA and DOD are continuing their collaborative efforts as part of the SLI program.

7. **How many CTV vehicles would be needed to support ISS operations, and what would be the on-orbit stay-time of each CTV?**

   Assuming a multi-purpose vehicle, preliminary studies have focused on the development and operation of three vehicles, initially configured to perform the crew rescue vehicle (CRV) function, with a minimum on-orbit stay time of six months. However, the specific number of vehicles, and on-orbit stay-times required, will depend on the final decisions related to the CTV, and launch vehicle requirements, as well as ongoing ISS studies, which will be a product of the ISTP update.

8. **It is reasonable to assume that a CTV would of necessity be more complex than a CRV given its "multipurpose" capabilities. Has NASA completed an**

analysis of the maintainability requirements and operations costs of keeping a CTV rather than a CRV on orbit at the Space Station? If so, what are the results of that analysis?

A multi-purpose CTV would be more complex than a CRV-specific vehicle. The rescue vehicle would need only to support the specific mission of returning crew safely to Earth, simplifying the requirements in areas such as on-orbit maneuverability, navigation and control, crew life support, launch load capabilities, etc. NASA has conducted a study that indicates that adding the crew rescue requirements to a CTV would result in a relatively small cost impact (approximately 10-20% increase in development cost) to the CTV design. No detailed analysis yet exists of the operational cost impact of a multi-purpose vehicle.

9. **The European Space Agency and the German Aerospace Agency participated in the X-38/CRV program until NASA's unilateral decision to terminate the activity. What would be the participation, if any, of those organizations in a CTV development program? On what do you base that conclusion?**

   Both the European Space Agency (ESA) and the German Aerospace Center (DLR) have indicated an interest in participating in the development of a multipurpose vehicle such as the CTV. ESA was one of the participants in the trade study recently completed to examine options for ISS crew return and transfer in the context of the SLI program. NASA will hold more detailed discussions with ESA and DLR on potential future cooperation in the near future in the context of the negotiations with those agencies for the termination of their agreements with NASA on X-38 cooperation. Specific elements of future cooperation on a CTV, or similar vehicle, will be determined based on NASA's requirements, the capabilities of interested partners, and applicable U.S. Government and NASA policies and regulations concerning foreign involvement in technology programs.

<u>Use of Soyuz Crew Return Capability</u>

1. **There have been conflicting claims ranging, from 2004 to 2006, on when the Russian obligation to provide sufficient Soyuz return vehicles to support a 3-person crew on the ISS would end. Do you have a written agreement with the Russians that clearly states the date at which the Russian Soyuz commitment ends? If so, what is that date? Do the Russians agree with your interpretation of the commitment?**

   NASA and the Russian Aviation and Space Agency (Rosaviakosmos) have an agreement, signed on June 11, 1996, in which Russia has agreed to provide 11 Soyuz vehicles for ISS crew. Under the currently agreed assembly sequence, the 11th Soyuz crew return vehicle will return to Earth in 2006. Senior officials of

Rosaviakosmos have repeatedly confirmed the commitment to 11 Soyuz vehicles for ISS crew during discussions with NASA staff over the last year.

2. **Based on NASA's past SLI briefings to the committee, NASA would have to seek the use of Russian Soyuz vehicles to meet its crew return commitments for a period of at least 5 years prior to the availability of a U.S. CTV.**

a. **Given the restrictions contained in P.L. 106-178 [Iran Nonproliferation Act of 2000], how specifically do you intend to obtain the use of the Russian vehicles?**

NASA has no plans to purchase Soyuz vehicles. Any potential acquisition of Soyuz crew return capability would be in full compliance with the Iran Nonproliferation Act of 2000.

b. **According to NASA, the last formal price for a Soyuz vehicle was about $65M. Based on two Soyuz per year to support a 3-person crew, the cost over 5 years would be about $650M, and the cost to support a 6-person crew over that time period would be about $1.3B. Have those costs been included in the Space Station cost estimates that you are preparing in response to the IMCE recommendations?**

The Russian-provided Soyuz vehicle will support three ISS crewmembers onboard the ISS Core through 2006. The potential requirement for crew return capability for more than three crew members will be determined, with our International Partners, as part of the process for selecting an approach to meet ISS research requirements, consistent with the recent findings of the ReMaP Task Force.

c. **In the absence of a credible U.S. CRV alternative over that time period, how do you intend to enforce price discipline in the acquisition of the Soyuz return capability?**

NASA has no plans to purchase Soyuz vehicles. NASA is currently developing, with our International Partners, a strategy regarding alternative crew return capability to meet the research requirements of ISS, consistent with the recent findings of the ReMaP Task Force. Under any strategy pursued, NASA will ensure that the U.S. Government receives goods and services commensurate with value provided.

d. **In light of the reduction in the number of Progress resupply vehicles being provided by Russia relative to its earlier commitment, what assurance do you have that Russia will be able to continue to supply sufficient Soyuz vehicles prior to the availability of a U.S. CTV?**

Russia continues to meet its commitments, including the provision of Service Module life support systems and launch of Progress and Soyuz spacecraft for re-supply, reboost, and crew escape functions, as documented in NASA's bimonthly Russian Performance Report to Congress. It is our expectation that Russia will continue to meet these commitments.

3. **Is there any way that a Soyuz-based crew-return capability could support a 7-man crew?**

   A Soyuz vehicle can accommodate only three crew. A six-person crew would require two Soyuz vehicles. A seven-person crew would require three Soyuz vehicles.

Cost-Benefit Analysis

1. **Was a quantitative analysis of the cost and benefits of the alternatives completed prior to the decision to terminate the X-38/CRV Program? If so, when was it done? Was it independently validated? Please provide the analysis to the Committee.**

   No, a quantitative analysis of the cost and benefits of alternative approaches, such as would be done in the project formulation phase, was not conducted. Based on an independent assessment of the X-38/CRV project, conducted in 1999, an X-38/CRV program would cost approximately $3 billion, depending upon the approach used in design, development, test and evaluation, and production. This estimate did not include the cost of Shuttle launches required as part of the development project. It is important to note that the latest cost estimates for X-38 were still highly uncertain, and a vehicle would have been available no earlier than 2008. Given that a multi-purpose vehicle could possibly be available in approximately the same timeframe, the Agency determined that pursuit of a single purpose vehicle of this investment magnitude was not the best use of NASA resources at this time.

2. **Did the analysis address the cost and schedule factors identified in the above questions?**

   As stated above in response to Question 1, no quantitative analysis of the cost and benefit was performed.